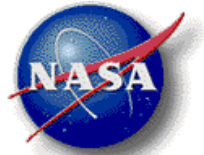# MAPGEN
Mixed Initiative Activity Plan Generator
for
MER

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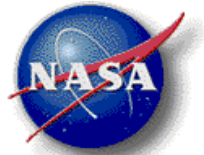|	
Alan Baba	JPL
John Bresina	ARC
Len Charest	JPL
Will Edgington	ARC
Ari Jonsson	ARC
Adans Ko	JPL
Bob Kanefsky	ARC
Pierre Maldague	JPL
Paul Morris	ARC
Kanna Rajan	ARC

Build, integrate, test and deploy a robust ground based Mixed Initiative Planning/Scheduling tool for Science Activity Planning
within the setting of an actual NASA mission

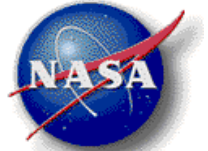To *increase* Science Return and *reduce* Risk
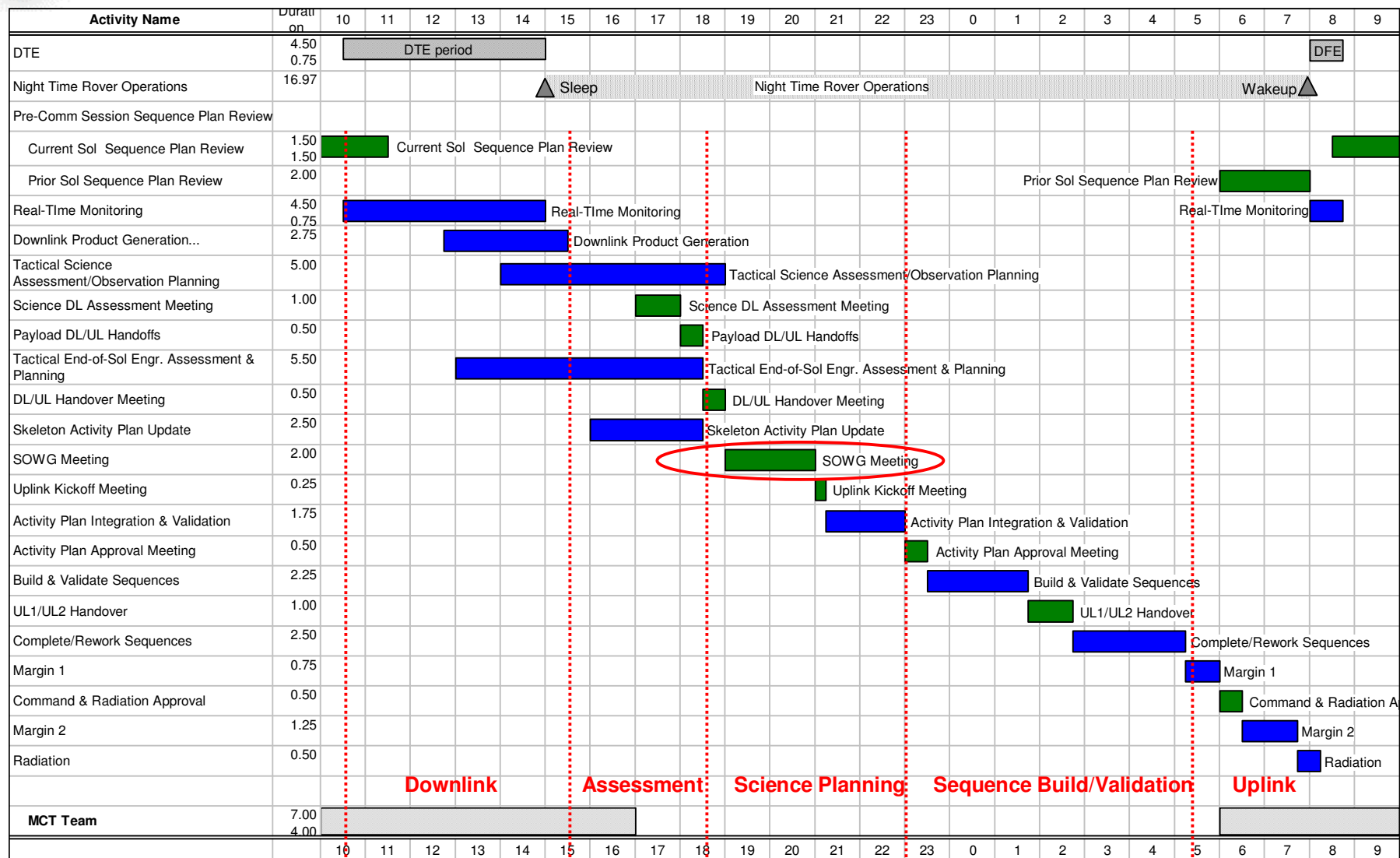
using advanced Planning & Scheduling capabilities

for MER

Integrate Ames' designed Constraint-based Planning technology with existing JPL Activity Planning tool (APGEN) within current uplink process for MER
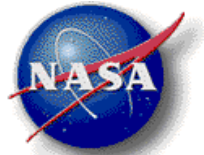
Impact of MAPGEN on Tactical Uplink Process

Activity Name	Duration	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9
DTE	4.50 0.75	DTE period																						DFE	
Night Time Rover Operations	16.97						Sleep		Night Time Rover Operations														Wakeup		
Pre-Comm Session Sequence Plan Review																									
Current Sol Sequence Plan Review	1.50 1.50	Current Sol Sequence Plan Review																							
Prior Sol Sequence Plan Review	2.00																				Prior Sol Sequence Plan Review				
Real-TIme Monitoring	4.50 0.75	Real-TIme Monitoring																					Real-TIme Monitoring		
Downlink Product Generation...	2.75			Downlink Product Generation																					
Tactical Science Assessment/Observation Planning	5.00					Tactical Science Assessment/Observation Planning																			
Science DL Assessment Meeting	1.00							Science DL Assessment Meeting																	
Payload DL/UL Handoffs	0.50								Payload DL/UL Handoffs																
Tactical End-of-Sol Engr. Assessment & Planning	5.50				Tactical End-of-Sol Engr. Assessment & Planning																				
DL/UL Handover Meeting	0.50									DL/UL Handover Meeting															
Skeleton Activity Plan Update	2.50						Skeleton Activity Plan Update																		
SOWG Meeting	2.00								SOWG Meeting																
Uplink Kickoff Meeting	0.25									Uplink Kickoff Meeting															
Activity Plan Integration & Validation	1.75											Activity Plan Integration & Validation													
Activity Plan Approval Meeting	0.50														Activity Plan Approval Meeting										
Build & Validate Sequences	2.25														Build & Validate Sequences										
UL1/UL2 Handover	1.00																	UL1/UL2 Handover							
Complete/Rework Sequences	2.50																	Complete/Rework Sequences							
Margin 1	0.75																				Margin 1				
Command & Radiation Approval	0.50																				Command & Radiation A				
Margin 2	1.25																				Margin 2				
Radiation	0.50																				Radiation				
		Downlink					**Assessment**			**Science Planning**					**Sequence Build/Validation**						**Uplink**				
MCT Team	7.00 4.00																								

| | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Courtesy: Jim Erickson

Kanna Rajan MER P&S IS-Wkshop 9/5/02

- Part of the Ground Data System for Mars03 since Oct01.

- Requirements and Design reviews by MER project completed June02.

- First delivery (engineering) to project June02.
  - Basic domain MER domain model for an approach Sol
  - Stable interface design and implementation of procedural based APGEN system with declarative forms of Planner modeling
  - Planner core infrastructure includes capabilities to
    - Activity Decomposition
    - Reason over resources using flexible temporal plans
    - Goal Rejection
    - Active constraint maintenance
    - Simple activity explanation
    - Participation in end-to-end uplink flow Thread-Test July02.

- Survived one MER project budget exercise in Jan02!

- Yet to see results from current project budget exercise!
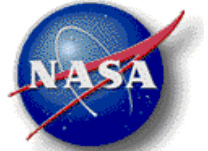
- Formal deliveries for
  - GDS7   Oct02
  - GDS8   Feb03
  - GDS8.5   June03   (all core capabilities included)
  - GDS9   Sept03   (post-launch domain model updates)

- Expected functionalities include:
  - Resource reasoning using an external (sw) expert model
  - Resource explanation facility
  - Ability to provide advanced Mixed-Initiative control features in various modes of operation
    - Fully automated planning
    - Planning with resource fixing by the user
    - No search, but active constraint maintenance only (APGEN look-alike)

- Participation in:
  - ORT's (Operations Readiness Tests)
  - Field Tests
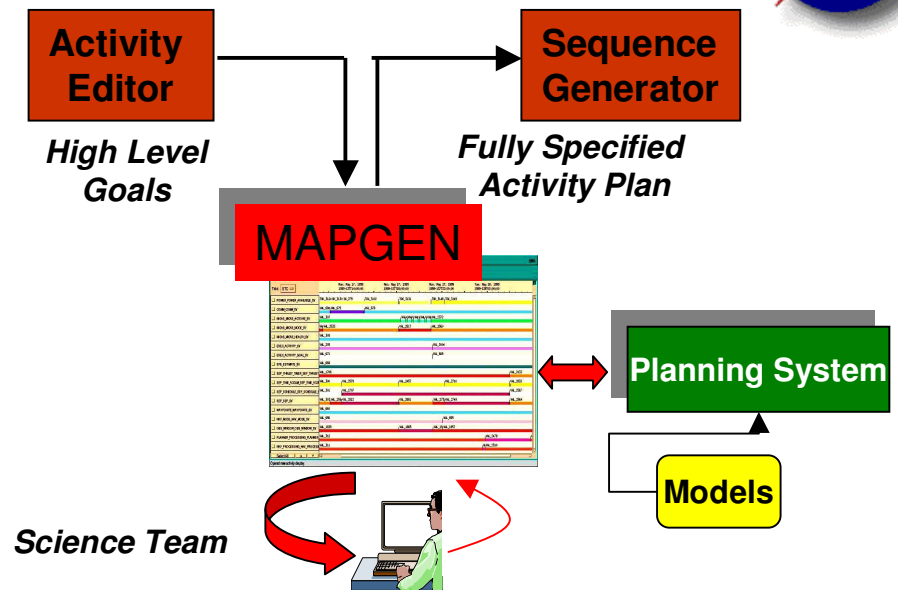 - Usability Workshop for MER Scientists and Ops personnel
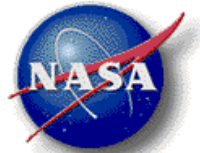
Goal: To build a robust ground based Mixed-Initiative (MI) Planning/Scheduling system for use by Mission Scientists and MER Ops Personnel.

Objectives: Use of automated P&S techniques working in concert with MI techniques to generate resource bound plans using flexible temporal plans.

Key Innovations:

- Reasoning over resource bounds using MI approaches for flexible temporal plans
- Advanced constraint-based reasoning techniques coupled with a fixed-schedule plan visualization.

Activity Editor — High Level Goals

Sequence Generator — Fully Specified Activity Plan

MAPGEN

Planning System

Models

Science Team

NASA Relevance:

- Providing robust resource allocation decisions
- Enforcing more downstream constraints in plans
- Active constraint maintenance for enforcing mission/flight rules
- Framework for a Multi-mission ground-based science/operations tool for NASA.

Accomplishments to date:

- FY02 Prototype effort leads to entry into Mission Oct01.
- Requirements and Design review by mission, June02.
- First delivery to mission and participation in Thread-Test, July02.

Schedule:

- FY01: Prototype demonstration for Activity Planning incl. Basic APGEN/Planner integration, simple model for resource computation, basic explanation facility.
- FY02: First Engineering Delivery June 02 for Thread-Test-C incl. first use of formal MER model, Requirements/Design reviews, basic implementation of core resource reasoning capabilities.
- FY03: Deliveries for Oct02, Jan03,June03, Sept03. June03 delivery incl. full planner functionality. Final Sept03 delivery includes updates to MER domain models.
- FY04: Testing, Operations Readiness Tests and actual surface mission Ops Jan-April04.

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